RECONNAISSANCE REPORT

COASTAL FLOOD PROTECTION
REVERE, MASSACHUSETTS

- ROUGHANS POINT
- POINT OF PINES
- REVERE BEACH
- OAK ISLAND & VICINITY

Department of the Army
New England Division
Corps of Engineers
Waltham, Mass.

FEBRUARY 1980

RECONNAISSANCE REPORT

COASTAL FLOOD PROTECTION

REVERE, MASSACHUSETTS

(1) ROUGHAN'S POINT
(2) REVERE BEACH
(3) POINT OF PINES
(4) OAK ISLAND AND VICINITY

FEBRUARY 1980

RECONNAISSANCE REPORT
COASTAL FLOOD PROTECTION
REVERE, MASSACHUSETTS
TABLE OF CONTENTS

TABLES

RECONNAISSANCE REPORT
COASTAL FLOOD PROTECTION
REVERE, MASSACHUSETTS

FEBRUARY 1980

I. AUTHORITY

Reconnaissance investigations were accomplished under authority contained in Section 205 of the 1948 Flood Control Act, as amended by Public Law 87-874 and subsequent Acts. Specific authorization to expand the reconnaissance study is contained in OCE 1st indorsement dated 19 July 1979. This report has been prepared in accordance with ER 1105-2-50, dated 3 November 1975. Federal assistance was requested by letter dated 23 October 1978 from the Honorable George Colella, Mayor of the city of Revere, Massachusetts.

II. SCOPE OF STUDIES

a. General. Interim studies of reconnaissance scope considered flood protection for four separate study areas, based upon geographic location and diverse flooding problems (See attached map). These areas (reaches) are (1) Roughan's Point, located near the Winthrop-Revere Boundary; (2) Central Beach, including Crescent Beach, Revere Beach and Revere Beach Parkway located to the north of Roughan's Point; (3) Point of Pines, the northeasterly tip of the city of Revere, at the mouth of the Pines River; and (4) Oak Island and vicinity on the westerly side of the Revere Beach/Point of Pines peninsula.

b. Topographic Surveys. U.S. Geological Survey maps (scale 1:24,000 and 10 foot contour intervals), plans furnished by State and local interests, and on-site inspections provided topographic survey information for this study.

c. Economic Investigations. An initial survey of flood damages, caused by the February 1978 blizzard, was made by the city of Revere. A detailed field survey and economic evaluation of damages was performed by Corps of Engineers personnel, in cooperation with city officials, during March-April 1979.

d. Office Studies. Office studies consisted of hydrologic and economic analyses, development of alternative flood control plans and preparation of preliminary cost estimates for these plans.

e. Field Reconnaissance. Field inspections have been made of the problem areas along the entire length of the project area. Interviews with local residents within flood prone areas were accomplished by damage survey specialists.

III. PRIOR REPORTS

The following descriptions outline several prior reports that have been prepared, addressing flood problems along Revere Beach and the Saugus and Pines Rivers.

a. The Division Engineer's report on restoration of Revere Beach was submitted to the Chief of Engineers on 1 June 1949. It was later printed in House Document No. 146, 82d Congress, 1st Session. The Chief of Engineers recommended that the United States adopt a project for the protection and improvement of the shore of Revere Beach Reservation between Northern Circle (Carey Circle) and a point near Shirley Avenue. The Metropolitan District Commission (MDC) constructed part of the project during 1954.

b. A report on "Flood Control for Saugus Branch Brook, Linden Brook and Town Line Brook," dated 15 March 1955, was prepared by a consulting engineer for the Metropolitan District Commission. The work proposed for the Saugus River Basin included (1) a reinforced concrete conduit along the upper portion of Town Line Brook and a paved open channel for the lower portion, and (2) a reinforced concrete conduit along the lower reach of Linden Brook. Both improvements conveyed flows to a common pumping station with an outlet conduit to the Pines River. The recommended measures have been completed with the exception of the pumping station.

c. A report on a "Pines River Detention Basin" was prepared by a consulting engineer and submitted to the Metropolitan District Commission in January 1965. This report considers the merits of a detention basin near the confluence of the Town Line and Linden Brooks in lieu of the pumping station recommended in the 1955 report. This proposed plan has not been implemented at this time.

d. A "Beach Erosion Control Report on Cooperative Study of Revere and Nantasket Beaches, Massachusetts" was submitted 28 March 1968. It was later printed in House Document No. 211, 91st Congress, 2nd Session. The Division Engineer recommended that Revere Beach be widened by placement of suitable sandfill along 13,000 feet of beach fronting the Metropolitan District Commission Reservation, thus furnishing a recreational and protective beach averaging 195 feet in width beyond the mean high water line. Completion of the advanced design phase of the project was deferred during the period from 28 February 1975 to 31 October 1978 because of the lack of non-Federal participation and cooperation. However, by letter dated 31 October 1978 the MDC has agreed to participate in project construction and the study has been reactivated. The proposed beach restoration project is currently in the preconstruction planning phase with construction scheduled to be initiated in 1982.

e. A report on "Flood Control and Navigation, Saugus and Pines Rivers Basin" was submitted by the Division Engineer on 10 June 1970 to the Chief of Engineers. The report focused on flood problems in the 47 square mile Saugus River Basin (including the Pines River) and along 6.5 miles of tidal shorefront in Revere and Lynn. It was recommended that no structural improvements for the reduction of flood damages be undertaken at that time.

IV. DESCRIPTION OF AREA

a. General. The city of Revere is located on the Massachusetts coast about two miles northeast of the city of Boston. About one-fifth of the area is a salt marsh adjacent to the Pines River estuary, and about one-third of the city, including the marsh area, is below elevation 10 feet, mean sea level (msl). The remainder of the city is gently rolling with a few steep hills, the highest elevation being at the reservoir on Fennos Hill at about 192 feet above msl. Most of the land above 10 feet msl is fully developed and, for all practical purposes, any new development could be expected only at the expense of existing uses. The population of the city is about 45,000, and on peak summer days more than 20,000 people visit the 3-1/2 mile long Revere Beach for recreational purposes.

b. Area Characteristics.

(1) Roughan's Point. This low lying, ocean front area in the Beachmont section of Revere consists primarily of summer and permanent residences in an 85-acre watershed. Thirty-three acres of this property is subject to flooding on almost a yearly basis. Existing protection consists of a concrete seawall along the easterly shore having a top elevation of about 17 feet above msl. The northerly facing shoreline is only protected by a stone dike having a top elevation of about 12 feet above msl. The area is primarily subjected to flooding from wave overtopping and inadequate pumping facilities.

(2) Revere Beach and Crescent Beach. The beach area consists of a 15,000 foot strip of shoreline adjacent to Revere Beach Parkway. Once a commercial area with an amusement park and recreational facilities, the area is presently being redeveloped. A concrete seawall at about elevation 16 feet msl extends along the entire length of this area. Flooding results from wave overtopping of this wall.

(3) Point of Pines. The Point of Pines area is a highly developed, permanent, middle-class residential district. This northern most shorefront area of Revere, extending a total distance of 4,600 feet to the General Edwards Bridge, has built-up sand dunes for about 1,500 feet, which act as some protection for the area,

while the remaining shorefront has a concrete seawall. Flooding occurs primarily from wave overtopping of the existing seawall and, to a lesser extent, the sand dune area.

(4) Oak Island. The area referred to as Oak Island and vicinity includes the salt marshes and land surrounded by the Pines River on the westerly side of the penninsula. Specifically, this reach includes the residential areas on Oak Island, Mills Avenue and in the vicinity of Diamond Creek. Most homes on Oak Island, with the exception of those around the low lying perimeter, are above the flood damage elevation.

(5) Saugus River. The Saugus River drains an area of 47 square miles including all or parts of 11 cities and towns centered approximately 10 miles north of Boston. The river forms at Lake Quannapowitt in the northern part of Wakefield and follows a meandering but general southeasterly course for 13 miles through Lynnfield, Saugus and Lynn to its mouth at Lynn Harbor. The lower 4.5 miles of the river are tidal and the lower 2.0 miles are navigable.

(6) Pines River. This is the principal tributary of the Saugus River. It is formed at the junctions of the Town Line and Linden Brooks in the northwestern part of Revere, follows generally an easterly course for 2.5 miles, then flows northerly about 1.2 miles to its junction with the Saugus River near Point of Pines. The Pines River is tidal throughout its length.

c. Topography and Geology. The Saugus-Pines watershed consists of a distinct region of both upland and lowland topography. Elevations range from sea level to as much as 170 feet above sea level. The lowland section, which once consisted mainly of salt marshes and alluvial deposits, constitutes less than one-third of the watershed area. Some of this area is now filled. The bedrock underlying the lowland section is argillite of sedimentary origin locally known as the "Cambridge Slate". The upland section is of rough, broken topography largely controlled by bedrock which is frequently exposed. The pre-glacial bedrock topography has been only modified by glacial deposition, while in most of the lowland section it has been deeply buried by glacial till and thick clay.

d. Maps. Topography of the Revere area is shown on U.S. Department of the Interior Geological Survey Maps indexed as Lynn Quadrangle and Boston North Quadrangle, at a scale of 1:24,000.

V. FLOOD HISTORY

Flooding in Revere is not a new problem. It has been experienced since the area was first settled over 200 years ago, with severe flooding occurring on an average of every eight years.

The more notable recorded floods and storms, as described below, occurred in December 1909, March 1931, April 1940, November 1944, December 1959, May 1967, February 1972, February 1978, and most recently during January 1979.

26 December 1909

The "Christmas Gale" produced the third highest tide, 10.0 feet above msl datum, in over 250 years of unofficial record at Boston. Historical records describe a wind velocity of about 85 miles per hour.

4 March 1931

The "northeaster" of March 1931 brought severe winds and high seas. A maximum tide of 9.2 feet, msl was recorded in Boston during this storm.

21 April 1940

The storm of 1940 brought high tides and strong winds. Boston Harbor recorded maximum stillwater tide heights to be 9.3 feet msl.

30 November 1944

The tide elevation observed in Boston on 30 November was 8.8 feet above msl datum. This storm was classified as a "northeaster" with strong winds prevailing from the north and northeast.

29 December 1959

During the northeaster of 1959, there was extensive damage at Revere Beach, with considerable loss of sand and undermining along the seawall due to heavy wave action. Major damage occurred at Roughan's Point (45 homes), Point of Pines (120 homes), and the Mill Avenue area (30 homes). Also many commercial establishments were affected due to overtopping of beaches and walls causing flooding in low areas.

26 May 1967.

This storm came especially late in the season. The "northeaster's" movement was slow due to a blocking high pressure ridge, and coincident spring tides combined with gale force winds caused extensive beach erosion. In Boston, maximum tide heights reached 9.0 feet, msl.

19 February 1972.

A deep low pressure area moving at about 25 miles per hour over outer Cape Cod produced storm surges of 4.0 feet at Boston, superimposed on the coincident spring tides. Observed maximum tidal elevations in Boston reached 9.1 feet, msl.

7 February 1978.

While areas were still in the process of recovering from the effects of the 20 January 1978 blizzard, New England was struck by one of the most intense, persistent, severe winter storms of record. The storm moved slowly eastward just south of New England as a circular upper atmospheric low moved over the surface circulation. It produced intensely strong winds including recorded gusts of 79 mph and great amounts of snow over most of southern New England. Tidal elevations in Boston reached the highest recorded at 10.3 feet, msl. It is estimated that this storm had a frequency of occurrence of once in 100 years. Aerial photographs of the project area, taken approximately one week after this storm, are included in this report.

21 January 1979.

Heavy rains and strong onshore winds galed from the northeast to create high tides and flood conditions in Revere. However, just before the high tide, winds unexpectedly shifted and flood losses were thereby reduced.

VI. FLOOD DAMAGES

The following analysis of flood damages, experienced during the record February 1978 storm, was obtained from field damage surveys, interviews with local residents and information provided by city of Revere officials. For the purposes of this study, the areas referenced as "Zones" in the economic analysis are the same as the "Areas" previously described in Section IV.

Zone 1 is Roughan's Point, an area bounded by Eliot Circle, Atlantic Avenue, Endicott Avenue, and the ocean. It is a very compact neighborhood with a church, a synagogue, a local school and some commercial establishments. In the 1978 flood, the area suffered the heaviest losses in Revere. The concrete seawall does not extend along the north facing shoreline, leaving this area particularly vulnerable to high waves. In the 1978 flood, the water level was high enough to damage the first floor of many homes.

The estimated average annual flood losses at Roughan's Point based on the full range of flood events, are $3,085,400. Recurring losses for the stillwater elevation of the 1978 flood are estimated at

$6,538,400. There would be approximately 250 residences damaged during a recurrence of the 1978 flood. Total physical and non-physical losses to residential structures are estimated to be $5,924,900 or an average loss of $23,696 per residence. The attached newsclip, taken from the Boston Globe of 19 February 1978, vividly depicts the hardships suffered by Beachmont residents during the "Great Blizzard".

Zone 2 is the central beach area, including Crescent Beach and Revere Beach. Zone 2 extends from Roughan's Point to Point of Pines but does not include the Oak Island area. This area has the most heavily used public beaches in Revere and at one time the entire shoreline of this area was lined with commercial establishments such as an amusement park, bars, arcades, and fast food establishments catering to tourists. There are still some of these establishments along the northern portion of the beach, but the majority of the buildings, including the amusement park, have been torn down and the land has been cleared and readied for development. Plans have been prepared by the town of Revere, the MDC, the MBTA, and private concerns for the redevelopment of this area. The plans are for the construction of 2 residential complexes, one to be luxury apartments and an elderly housing project, and the other to be condominiums. The MDC plans to build a park and the MBTA is planning to extend the Blue Line public transportation system, to rebuild the Wonderland Station, and to construct a parking garage.

Average annual losses for Zone 2, based on a full range of flood events, are estimated at $973,200. Recurring losses for the stillwater elevation of the 1978 flood are $3,313,000. The recurring losses break down into $1,200,000 - residential, $715,000 - commercial, $747,000 - public, and $651,000 - automobiles. There would be losses to 380 residences or an average loss of $3,157 per residence in a recurring 1978 flood elevation. The commercial damage would be divided among 40 establishments with the Wonderland Dog Track suffering the greatest estimated losses of $160,000. Damage to public property in a recurring 1978 flood would include 2 schools with $219,000 in losses, MDC property with $170,000 in losses, and the Wonderland MBTA station with $646,000 in losses.

Zone 3 is the Point of Pines area. This is a well-defined neighborhood north of Zone 2 bordered by the ocean and the Lynnway. It is a higher income area than Roughan's Point with larger homes and yards. There is a fire station, a school, two churches, and several commercial establishments in the neighborhood.

The average annual damages for Zone 3 are estimated at $515,000 and the recurring losses for stillwater elevation of the 1978 flood are $2,777,000. There are 310 residences with combined losses of $2,100,900, averaging $6,774 per residence. The flooding at Point of Pines was not as severe as that at Roughan's Point. In 1978 water

levels did not reach the first floors of the residences at Point of Pines. Much of the damage was caused by the flooding of basements with damage to furnishings, heating systems, plumbing, and stored belongings.

Zone 4 was subdivided into three separate areas for the economic analysis, namely; the Diamond Creek and Pines River area, the Riverside area, and Oak Island. These 3 geographically separate areas are combined because they all flood from the same source, the Pines River. During storms the ocean rises causing backwater along the river, while at the same time the wetlands reach their limit of water retention. The result is that the water levels slowly rise, inundating property bordering the wetlands and rivers.

Average annual losses for the entire zone are $465,250 and the recurring losses for the 1978 flood elevation are $1,715,000. The Pines River area is inland of Point of Pines. The total recurring losses are $393,000, two hundred residences would have losses of $133,000. The Oak Island area has $1,080,000 in recurring losses to 350 residences and total recurring losses of $1,126,200. The Riverside area extending from the Salem Turnpike to the North Shore Road and fronting the wetlands has $196,000 in damages. There are $50,000 in losses to 65 residences. Total residential losses for Zone 4 are estimated to be $1,263,000.

The 1970 U.S. Census listed approximately 14,000 residential structures in Revere. In the 1978 storm about 10% of these structures were damaged. Total estimated flood damage for a recurrence of the 1978 flood would be $14.4 million with $10.5 million in lossses to residences, or 72% of the total.

The 1978 flood, used as the index for measuring damages in Revere, came directly after a severe blizzard. When the damage survey specialists from the Army Corps of Engineers were assessing damages they separated these two events and only considered those damages caused by the flooding. There are two types of flood losses, physical and non-physical. Physical losses include such things as damages to structures and contents. The non-physical losses take into account a wide variety of losses attributable to flooding such as loss of work, costs of temporary housing and food, etc.

There are other expenses associated with severe flooding such as occurred in Revere. In addition to the measured damages previously discussed, there are one-time losses associated with flooding which are not accountable as damages. These costs include the expenditures by twenty Federal, State, and local emergency assistance programs. These emergency expenses accrued due to both the storm and the flood. At least some of these expenditures would be prevented by the proposed project. The city of Revere provided a list of the agencies involved in emergency operations during the 1978 storm and also in

the subsequent rehabilitation operations. The list includes: 1) HUD - community block grants, temporary housing, insurance, and repairs 2) Small Business Administration low interest loans 3) Department of Labor - unemployment insurance 4) Department of Agriculture - food stamps 5) Federal Disaster Assistance Administration 6) Community Services Administration - grants for food and fuel 7) HEW - grants to the elderly 8) Federal Highway Administration 9) Army Corps of Engineers - emergency rehabilitation 10) Massachusetts National Guard. In addition to these agencies there were extraordinary expenses incurred by the Revere police and fire departments, and by the MDC.

Table 1 summarizes estimated annual and recurring losses by zones and by category, not including costs incurred by emergency services.

TABLE I

1978 Flood Damages by Zones

Zone	Annual Losses	Recurring Losses
1) Roughan's Point	$3,085,400	$6,538,400
2) Central Beach Area	973,200	3,313,000
3) Point of Pines	515,000	2,777,000
4) Total Zone 4	465,250	1,715,000
Diamond Creek and Pines River	---	393,000
Riverside of Point of Pines	---	196,000
Oak Island	---	1,126,000
TOTAL	$5,038,850	$14,343,400

1978 Flood Damages by Categories

Zone	Annual Losses	Recurring Losses
Residential		$10,488,800
Zone 1	$5,924,900	
Zone 2	1,200,000	
Zone 3	2,100,900	
Zone 4	1,263,000	
Commercial		1,266,500
Zone 1	281,300	
Zone 2	715,000	
Zone 3	116,500	
Zone 4	153,700	
Public		980,500
Zone 1	41,300	
Zone 2	747,000	
Zone 3	137,200	
Zone 4	55,000	
Automobiles		1,607,700
Zone 1	290,900	
Zone 2	651,000	
Zone 3	422,500	
Zone 4	243,300	

VII. PROPOSED PLANS OF PROTECTION

The following analysis of alternative flood control measures presents project descriptions and cost vs benefit data. The four study areas, namely, (1) Roughan's Point, (2) Revere Beach, (3) Point of Pines, and (4) Oak Island and vicinity are considered separately because the protection of each area is not dependent on flooding in adjacent reaches.

(1) The Roughan's Point (Beachmont) area of Revere is situated in a low-lying flood plain behind a concrete seawall. The seawall, constructed by the Mass. Division of Waterways in 1937, extends southerly from Simpsons Pier to the vicinity of Short Beach, a distance of about 1700 linear feet. The top of wall elevation is approximately 17 feet above mean sea level, while the approximate ground elevation at Broad Sound Ave., near the MDC pumping station is only four to five feet above mean sea level. During the February 1978 storm, 10 to 12 foot high waves overtopped the seawall and inundated the residential area with salt water as much as eight feet deep. Whereas the existing MDC pumping station is capable of pumping interior drainage during rainstorms, it was totally ineffective in reducing water levels caused by ocean waves. The problem at Roughan's Point was compounded by the fact that no concrete wall exits in the reach extending generally westerly from Simpsons Pier to Eliot Circle. This approximately 1000-foot long reach is only protected by a riprap seawall which is about five feet lower than the concrete wall. During the February 1978 storm the extreme high tides and twelve foot high waves caused almost continuous overtopping and considerable damage to the revetment. During the past summer the revetment was repaired by non-Federal interests, but the top elevation was not increased.

Several alternative plans for providing flood protection for the Roughan's Point area, against a recurrence of the February 1978 conditions, were considered. They included: (1) raising the existing concrete wall six feet and constructing a new concrete seawall from Simpsons Pier to Eliot Circle, (2) a stone breakwater offshore, (3) a floating breakwater offshore, (4) raising the existing 33 acres of flood prone land by ten feet, including 220 houses, and (5) a stone berm on the ocean side of the seawall. The reconnaissance study determined that plan (5) was the most reasonable plan that would provide a high degree of protection with mimimum adverse impact on local residents and the environment. Raising the existing seawalls would most likely be objectionable to some residents as it would obstruct their view of the ocean. Offshore stone breakwaters would be expensive to construct and maintain. Floating breakwaters would be ineffective against severe storms and filling of the existing flood prone area would be highly disruptive to local residents. It is estimated that approximately 5500 linear feet of stone protection could be placed from Short Beach to Eliot Circle on the ocean side of

the existing seawall, at a project first cost of approximately $15,000,000 (See attached sketch plan - Incl. 2). This would provide complete protection for the entire Beachmont area against a recurrence of the February 1978 flood and would prevent annual damages (annual benefit) estimated at about $3,000,000 taken at April 1979 price levels. Utilizing current rates of interest and amortization the annual cost of flood protection at Beachmont would be $1,100,000. This analysis results in a positive benefit to cost ratio of 2.7 to 1.0. This plan is complete within itself and is incrementally justified.

(2) The second study area is the longest reach, extending about 13,000 feet from Eliot Circle, along Crescent and Revere Beaches, to Carey Circle. Although most of the beachfront properties (arcades and amusement park) are gone, there is considerable pressure for private redevelopment of the area. During the February 1978 storm high waves and the tidal surge overtopped the seawall (top elevation 16± feet above mean sea level), inundated Revere Beach Blvd. and ran down to Ocean Avenue and the backshore area, thereby adding to the volume of water that was backing up through drainage ditches from the unusually high tides on the Pines River. These high energy conditions were generated by winds from the north and northeast and by an abnormally high tide. Considerable damage was sustained in low lying areas along Ocean Avenue and North Shore Road and the MBTA Wonderland Station was closed for several weeks due to the flooding.

Several alternative plans for reducing flood losses due to wave overtopping of the Revere Beach seawall were investigated. In the analysis of this flood zone it must be emphasized that complete flood protection for the backshore area could not be accomplished by improvements along the beachfront alone. Other improvements would have to be accomplished to prevent tidal backwater inundation through the system of tidal ditches which discharge to the Pines River. This could be accomplished by the construction of dikes and pumping stations (possibly along the B&M railroad embankment) or by construction of a hurricane barrier across the entrance of the Pines River in the vicinity of the General Edwards Bridge.

Basically the alternatives studied for Area 2 included (1) removal of the existing seawall and replacement with either a stepped concrete wall or curved face wall with a top elevation three to four feet higher than the existing wall, (2) raising the existing roadway elevation of the Revere Beach Blvd. from Eliot Circle to Carey Circle, (3) driving steel sheet piling on the beachside of the existing concrete wall, (4) raising the embankment between the Revere Beach Blvd. and Ocean Ave. south of Revere street and providing drainage outlets from the roadway to the beach (this plan is essentially the same as current MDC plans), (5) constructing a three to four foot high concrete "cap" on top of the existing seawall and

(6) replenishment of beach sand to dissipate wave energy away from the existing seawall. These plans had estimated first costs ranging from about $7,000,000 for the beach restoration to over $17,000,000 for the construction of a new higher seawall. (A sketch plan of the beach restoration is included as Incl. 2.) Because total benefits attributable to Plan (6) could only be utilized for properties immediately adjacent to Revere Beach Blvd. and not for the backshore areas, because of the local drainage conditions, the annual benefit for Area (2) was estimated at $924,000. Compared with estimated annual costs of $515,000 for the beach restoration plan, the benefit to cost ratio would be about 1.8 to 1.0. All other plans for flood control in Area 2 were either impractical or not economically justified, or did not provide protection against a recurrence of the February 1978 storm. However, as noted in Section III of this report the restoration of Revere Beach is currently in a preconstruction planning phase under a separate Congressional resolution. It is anticipated that the proposed project, taken with proposed MDC improvements, will prevent flood damages to the Revere Beach area from wave overtopping.

(3) The third study area at Point of Pines extends for a distance of about 4600 feet from Carey Circle to the mouth of the Pines River at the General Edwards Bridge. Although this area is not as exposed to coastal flooding as the Beachmont area, due to protection from the Lynn-Nahant Causeway, it did suffer considerable damage during the February 1978 blizzard when the seawall was overtopped. The residential streets extending off Rice Avenue were inundated by sheet flow and because of snow and slush on the ground these flows ponded and could not reach the pumping station located near the bridge. The existing shorefront at Point of Pines has several different sectional configurations, including concrete wall with revetment, concrete wall without revetment, stone slope protection and sand dunes. Approximately 1500 feet of the total length consists of sand dunes located at the far northerly end of Point of Pines.

The basic plans of protection for this area would be similar to those previously discussed for the other damage zones, namely, raise existing seawalls, construct new, higher seawalls, place rock protection on the oceanside of the existing seawall, and raise the existing sand dunes. Because raising the existing seawall four to six feet would be objectionable to residents of Point of Pines, the selected plan would include placement of a cover layer of stone on the oceanside of the seawall and placement of addtional sand in the 1500 foot reach of the existing sand dunes. (See Incl. 2). Approximately 20,000 cubic yards of sand would be required, sea grass would be planted on the dunes and a drift fence would be included in the protected area. The plan of protection had an estimated first cost of $6,500,000 and would provide protection against a recurrence of

the estimated 100-year flood event. Annual benefits for this area are estimated at $480,000 while estimated annual costs are about $478,000. This analysis provides a benefit to cost ratio of 1.07 to 1.0.

(4) The fourth area studied encompassed all of the Pines River backshore tidal area and the major drainage system that discharges runoff from low areas to the east of North Shore Road. Major damage zones in this reach include Oak Island, Mills Avenue and local streets in the vicinity of Diamond Creek. Backshore protection could be provided by either of two alternative methods, namely (1) a tidal barrier across the mouth of the Saugus-Pines River or (2) tidal gates and pumping stations at the Diamond Creek outlet and at North Shore Road. Plan (1) would cost over $20,000,000 and would prevent tidal flooding in all the backshore areas, while Plan (2) has an estimated first cost of $4,000,000 but would not provide flood protection to low lying shorefront properties on Mills Avenue. The less expensive alternative would utilize the existing Boston & Maine Railroad embankment as a tidal dike. A gated outlet pipe and pumping station would be required where the interior drainage ditch flows into Diamond Creek (See Incl. 2). During flood periods the gates would be closed and the pumping station would discharge interior runoff and drainage through the railroad embankment. To protect lowlands near Island Street, five thousand linear feet of North Shore Road would have to be raised about four feet. Here again, tidal gates and a pumping station would prevent flood inflows from the Pines River. Annual losses for zone 4 are estimated at $438,000 while annual costs, based on the $4,000,000 project cost, are estimated at about $300,000, thereby providing a benefit to cost ratio of 1.45 to 1.0. Table II presents a summary of first costs, annual costs, benefits and a benefit-cost ratio for the selected plan of flood control improvments within each of the four study areas.

TABLE II

ESTIMATES OF FIRST COST, ANNUAL CHARGES AND ANNUAL BENEFITS

Proposed Plan	Estimated First Cost ($000)	Annual Charges ($000)	Annual Benefits ($000)	B/C Ratio
Area 1 (revetment)	$15,000	$1,100	$3,000	2.7
Area 2 (sand beach)	$ 7,000	$ 515	$ 924	1.8
Area 3 (revetment and sand dunes)	$ 6,500	$ 450	$ 515	1.15
Area 4 (flood gates and pumping station)	$ 4,000	$ 300	$ 438	1.45

VIII. CONCLUSIONS

Because the proposed plans of local flood protection for the Revere shorefront primarily involve placement of a revetment on the ocean side of existing seawalls above the normal high tide line, in areas that are not existing sand beaches, there are no significant adverse environmental impacts that should result from the proposed projects. During future detailed planning efforts, an Environmental Impact Statement (EIS) will be prepared and existing Executive Orders (EO) pertaining to flood plain zoning and wetlands management will be addressed.

Based on the reconnaissance scope investigation it was concluded that, due to the severe flooding and extreme hardships suffered by the residents of Revere during the February 1978 Blizzard, and again to a lesser degree during the January 1979 coastal storm, there is sufficient economic justification in the four study areas to allow Federal participation in the construction of coastal flood protection projects.

Preliminary coordination has been maintained with the Metropolitan District Commission (MDC) and Coastal Zone Management (CZM) office of the Massachusetts Dept of Environmental Protection (DEP) during the course of our study. The most recent discussion with CZM was to ascertain if our reconnaissance findings, for providing coastal flood protection along the Revere shorefront, were consistent with current State planning and if there were any on-going programs for assistance

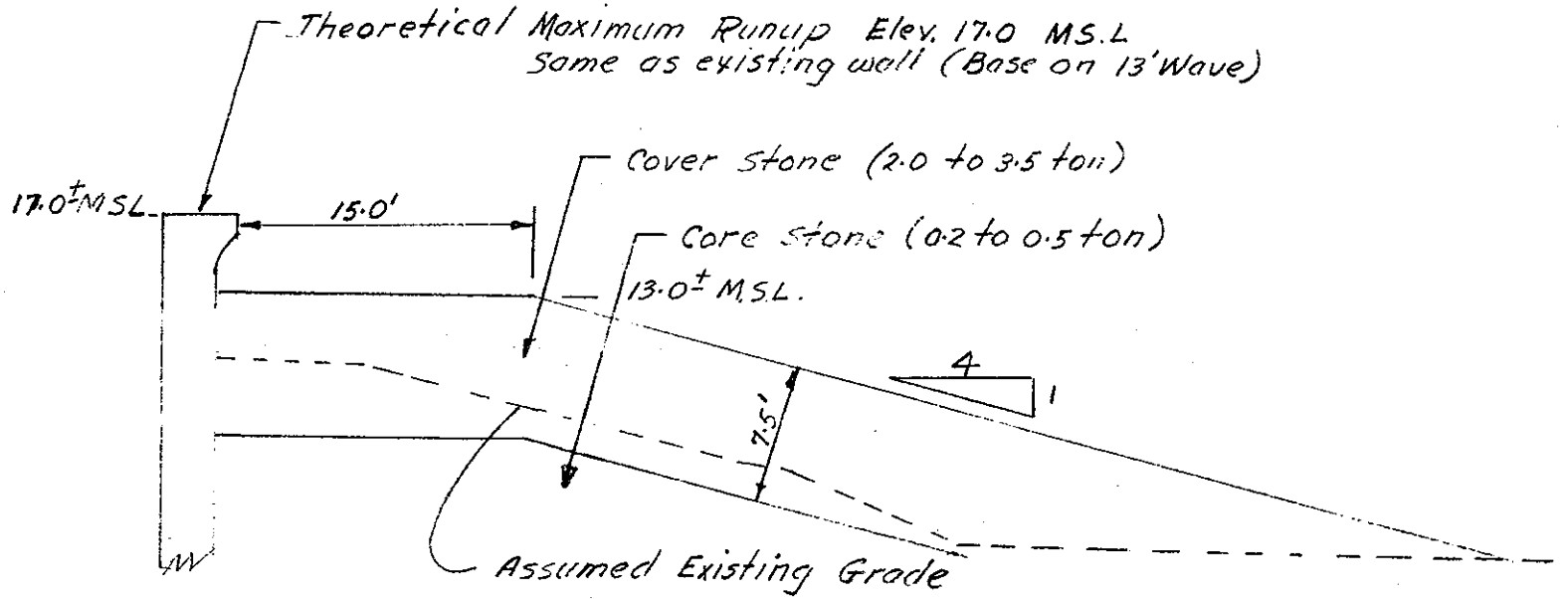
in this coastal zone. According to CZM the only work currently being undertaken for that area of Revere are two studies, namely, (1) reconstruction of the Wonderland MBTA Station and (2) MDC studies for beach improvements and park development along Revere Beach Blvd. The MBTA study would have no impact on the flood control improvements, while the MDC study is being coordinated with the Corps Revere Beach Restoration study which basically is Area 2 as described in this report.

IX. RECOMMENDATIONS

Revere city officials have expressed a need for early implementation of flood control improvements in Revere. It is therefore recommended that authorization and funding for detailed flood control studies of Roughan's Point, Point of Pines and Oak Island be included within the ongoing Southeast New England (SENE) study resolution. This would allow for early detailed environmental and engineering studies and would be in the best interests of Revere citizens.

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
(1) Map
(2) Cross Sections (5)
(3) Newsclip
(4) Photos (3)
(5) Letter (Mayor Colella)



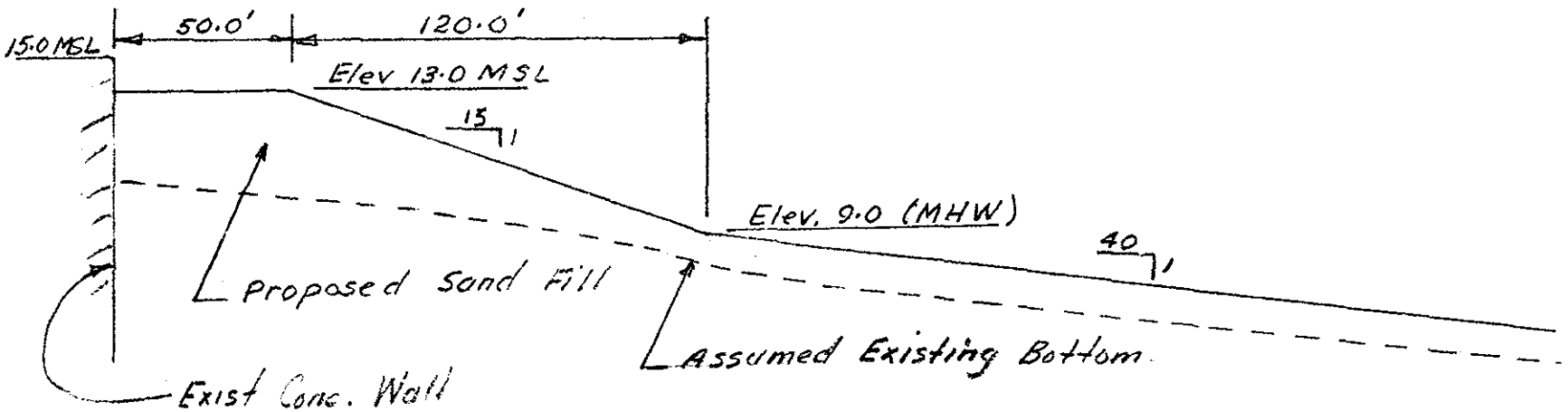
PROPOSED COASTAL FLOOD PROTECTION

REACH 1

REVERE, MASS.

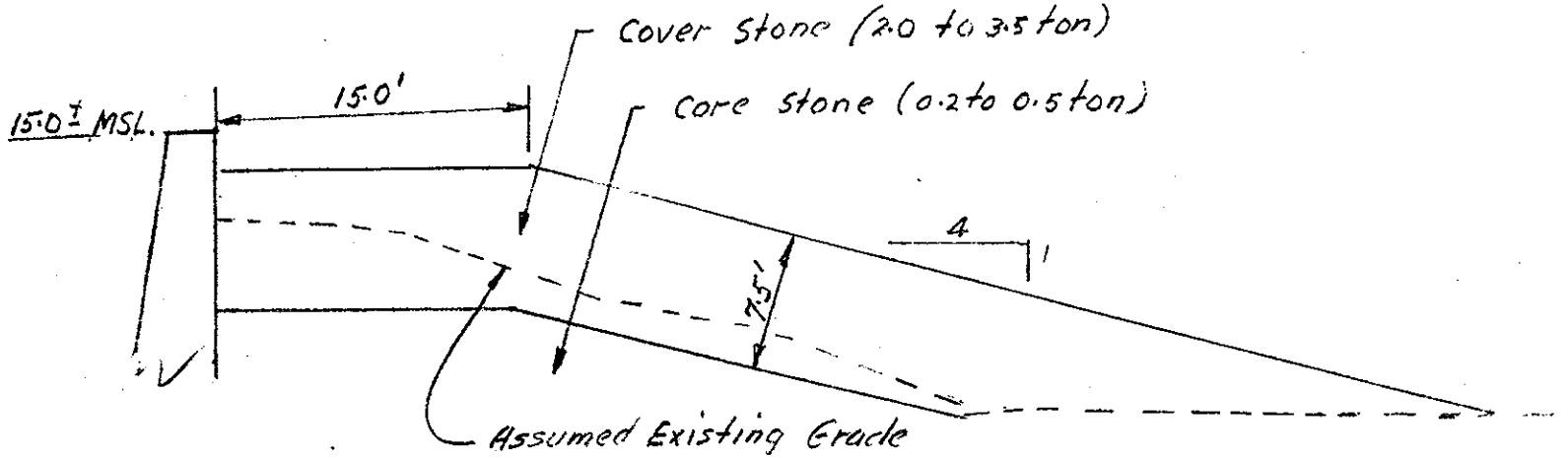
SCALE 1"=10.0'

INCL 2



PROPOSED COASTAL FLOOD PROTECTION
REACH 2
HORZ. SCALE 1" = 50'
VERT. SCALE 1" = 10'

Incl 2



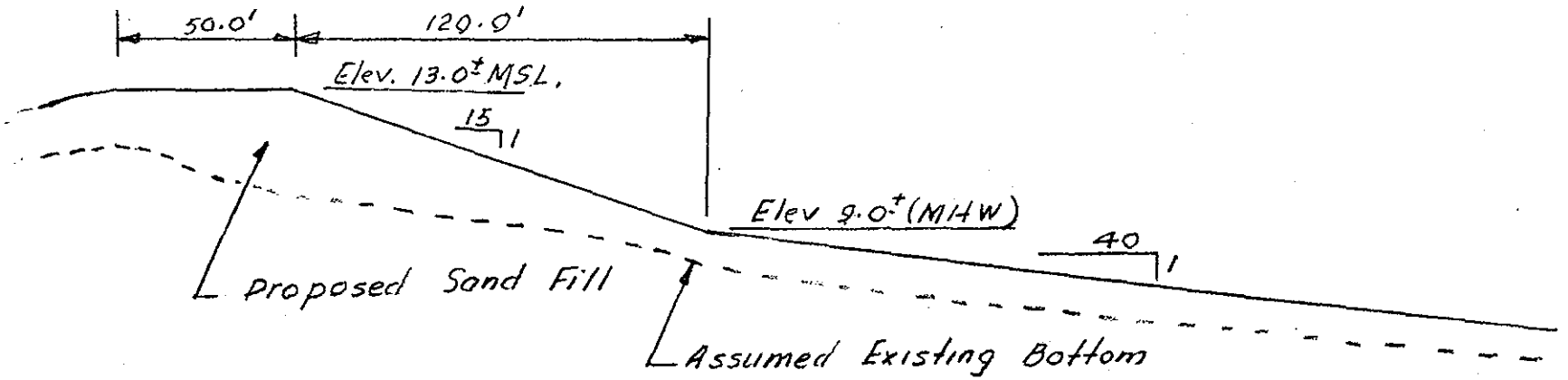
PROPOSED COASTAL FLOOD PROTECTION

REACH 3

REVERE. MASS

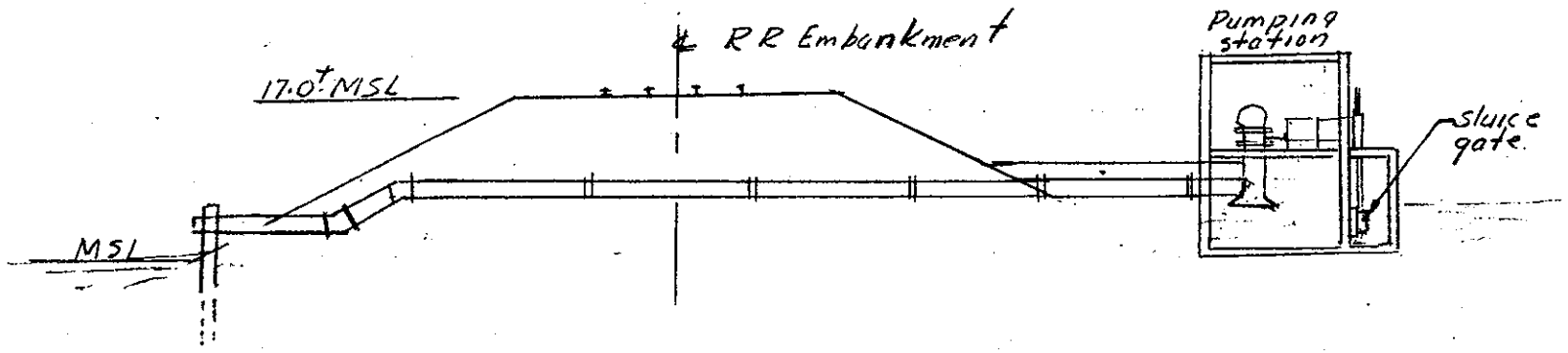
Scale 1"=10'-0"

INCL 2



PROPOSED COASTAL FLOOD PROTECTION
REACH 3
HORZ. SCALE 1" = 50'
VERT. SCALE 1" = 10'

INCL 2



PROPOSED COASTAL FLOOD PROTECTION

REACH 4

REVERE, MASS.

Scale 1" = 20'

INCL 2

A tide of despair runs in Beachmont after waves recede

The sea, in the worst of its moods, destroys.

It roars in one day, leaving destruction in its wake, and disappears just as quickly, lapping gently at the beachfront. It is the child who raids the cookie jar and feigns innocence, despite the crumbs on his face.

But in Beachmont, jutting out like a spur on the Revere shoreline, the damage runs deeper than the destruction, regardless of how devastating.

In Beachmont, human despair runs with the force of an undertow, long after the waves recede, after the sightseers go home, after the disaster crews go elsewhere.

It is a modest, blue-collar neighborhood of a few hundred families who save what extra money they have so that Joey might go to college someday. There are no frills. Nothing salted away for a rainy day. No fat bank account with money to put homes back on their foundations, to replace cars drowned in a furious sea.

The personal losses are great. For most, it is a time to start over. For a few, a time to give up. Some will move away from the sea, into Medford or Saugus. Others will try again, daring nature once more.

Hundreds strong, from all over Revere, they filed into the Federal Disaster Relief Center in the basement of St. Anthony's Church all week long. They came in search of low cost loans, of help with their taxes, of money for clothes and food.

Many carried with them all that they owned.

They stood in line for hours at the Red Cross table, in search of a voucher that would get them new eyeglasses, new dentures or perhaps merely a new walking cane.

They talked with federal representatives from the Department of Housing and Urban Development in search of a place to live, away from the cramped quarters of relatives and friends or the impersonal air of the Revere High School gymnasium.

Some had heard stories that mobile homes were en route, to be placed at the spot where their homes once stood. They were told that it wasn't so and instead were sent to a room at the nearest Ramada Inn.

By week's end, some of the losses would be replaced. New clothing and new shoes would be bought with money from the Red Cross. No one would replace the memories of a lifetime in the Beachmont neighborhood.

While they stood waiting in the relief center, a Revere city official moved from house to house on the shore side of Broadsound avenue, tacking up small red signs which read: "Notice. Dangerous Building." It was the equivalent of being condemned, unsafe for human habitation.

When, and if, they returned to Beachmont, it would be a different neighborhood. Some of the old neighbors will have moved. Those who remain will live in fear of the ocean just beyond the seawall, changing the atmosphere of a street that had survived in relative bliss since the Hurricane of '38.

The sea, in the worst of its moods, can tear a neighborhood apart.

In Beachmont, there is a hope that federal money, state aid and city assistance will make the area a neighborhood once more.

It is still too early for dollar estimates, too soon to tell just how many Beachmont homes will be saved, how many will be torn apart and carted off to the dump.

For the dozen or so knocked from their foundations, there is little hope. For the others, only time will tell.

But there is a confidence here that others will replace those that are gone and that Beachmont will once again become a neighborhood, however changed, on the edge of the ocean.

INCL 3

ROUGHAN'S POINT
11 FEBRUARY 1978

REVERE BEACH
11 FEBRUARY 1978

POINT OF PINES
11 FEBRUARY 1978

GEORGE V. COLELLA
MAYOR

THE CITY OF
REVERE, MASSACHUSETTS

OFFICE OF THE MAYOR
CITY HALL

October 23, 1978

Colonel John P. Chandler
Division Engineer
N.E. Division, U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Chandler,

The City of Revere requests that the Army Corps of Engineers undertake a study to investigate flooding conditions and to determine the economic feasibility of constructing a flood control project in the Revere Beach section of the City.

The Revere Beach section, because it is relatively flat with low ground elevations, is subject to flooding from several sources: stormwater runoff from intense rainfall, which the drainage system cannot handle; wave runup over the seawall along Revere Beach Boulevard; and water backup from Diamond Creek, when drainage through the county ditch is prohibited by high tides.

As you may be aware, there are several major public projects proposed for the Revere Beach area. These include the MBTA extension of the Blue Line; station rehabilitation and construction of the 1200 car garage at the Wonderland Station; the DPW Revere Beach Connector, which will cut across the City from the West, providing direct access to the MBTA garage; the MDC revitalization of the Revere Beach Reservation; and the ALBA Corporation Residential Development of 630 units.

At my request, a meeting of the involved state agencies was held on October 18, 1978 to discuss drainage and flooding considerations related to these construction projects. Representatives of the Army Corps of Engineers were also asked to attend the meeting. At that time, Mr. Paul E. Pronovost of the Planning Division mentioned that the Corps can undertake small scale studies to investigate flooding conditions from external sources. He explained that, at the City's request, the Corps could carry out a short-term study of 2-3 months duration (approximately $5,000) to determine the economic feasibility of a capital flood control program for Revere Beach.

Should the Corps concur with our request, the City would provide assistance in carrying out the project. I have assigned Terrence Geoghegan and Marion Craven of my Joint Development Office as contact people for the flood study. HUD

floodplain maps and maps of flooding conditions of the February 1978 Blizzard are available in the City's Office of Community Development.

Thank you for your attention to this request. The City of Revere looks forward to working with the Army Corps of Engineers on this complex problem.

Very truly yours,

George V. Colella
Mayor

GVC/lf

cc: Terrence Geoghegan
Marion Craven
Paul Rupp